July 13, 1965 J. S. SIMMS 3,194,536

PRE-STRESSED CONCRETE REINFORCED
STRAND TENSIONING DEVICE

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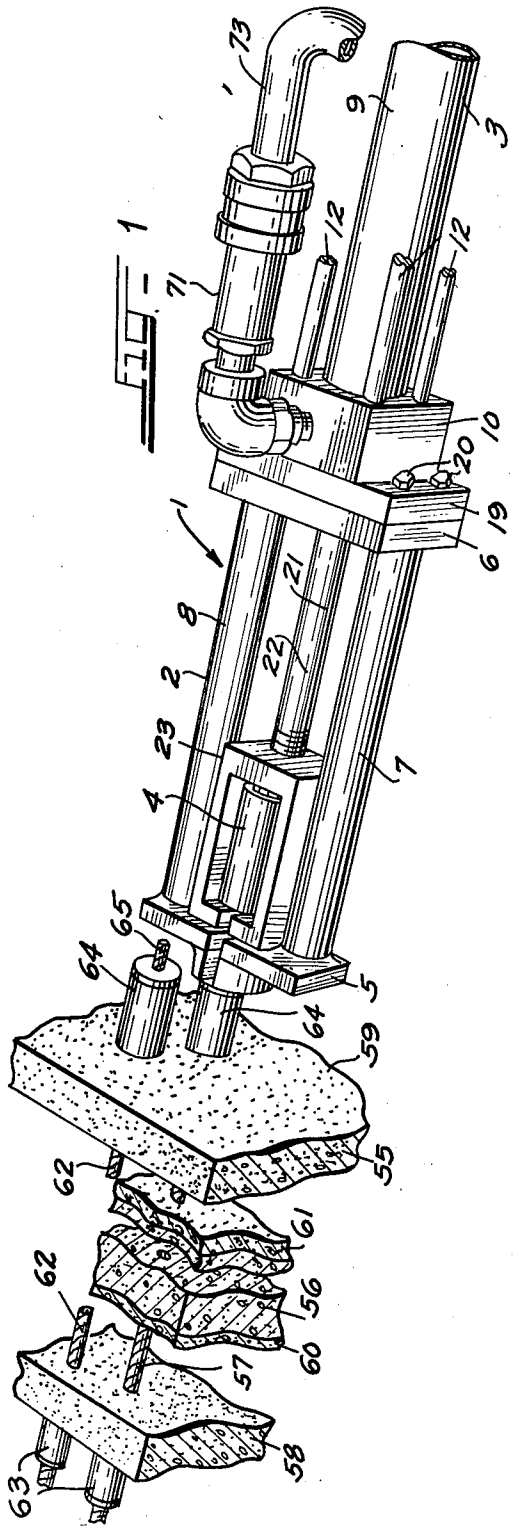


FIG. 1

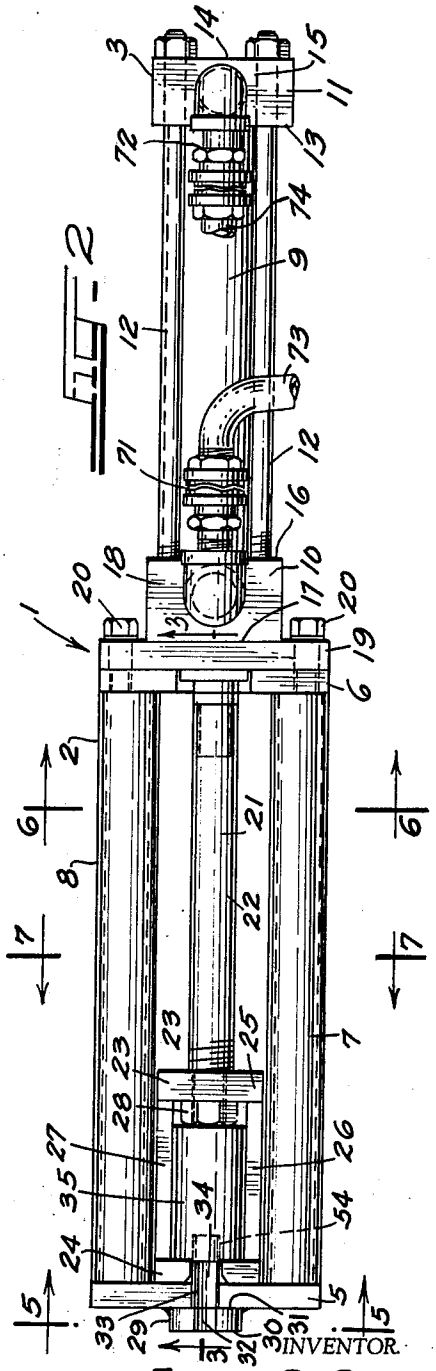


FIG. 2

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Fig. 3

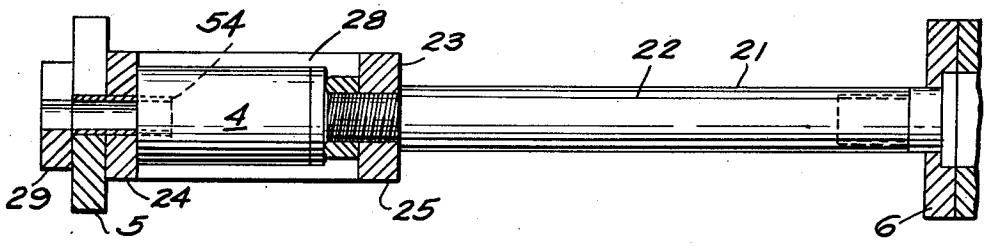


Fig. 4

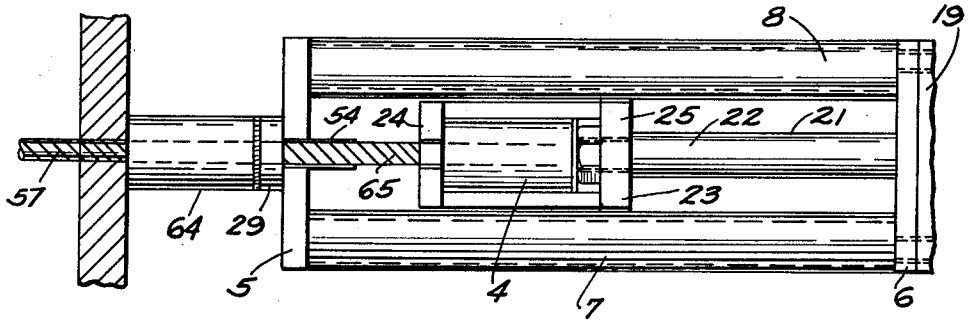


Fig. 5

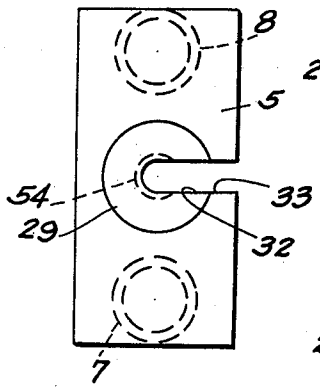


Fig. 6

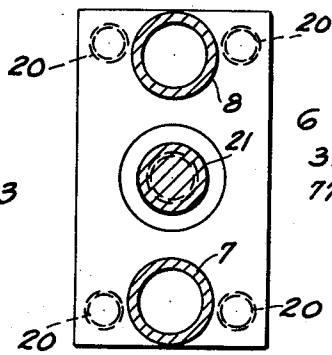
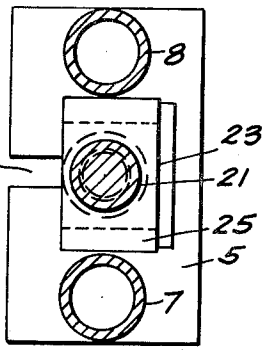


Fig. 7



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PRE-STRESSED CONCRETE REINFORCED STRAND TENSIONING DEVICE

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FIG - 8

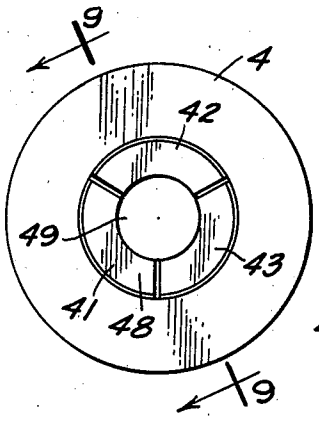


FIG - 9

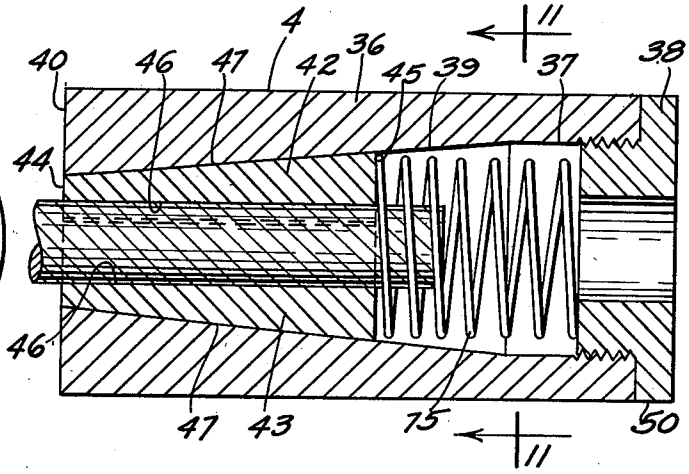


FIG - 10

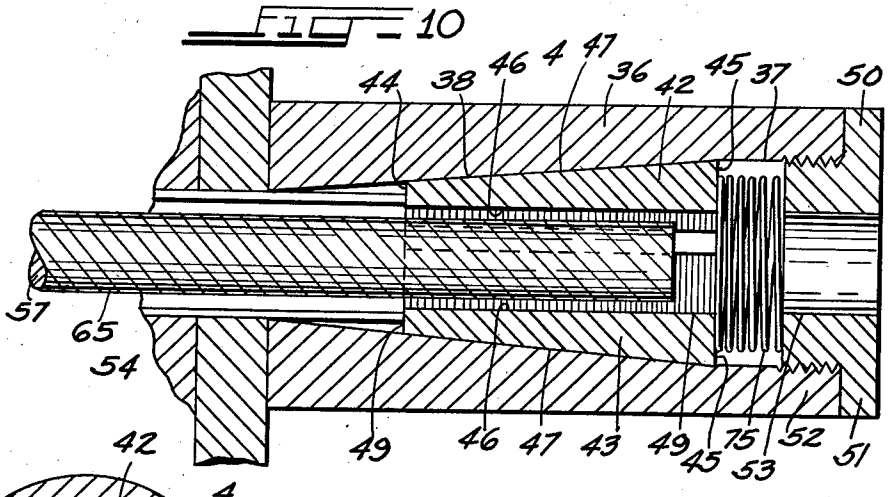
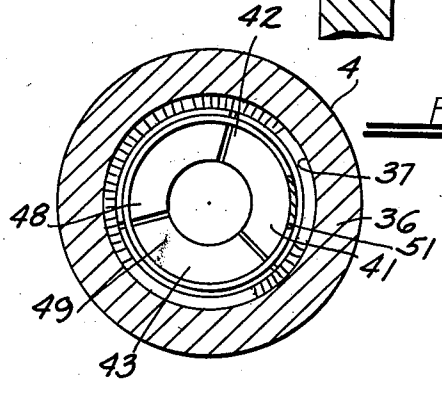


FIG - 11



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3,194,536

PRE-STRESSED CONCRETE REINFORCED STRAND TENSIONING DEVICE

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Filed Mar. 6, 1963, Ser. No. 263,182
5 Claims. (Cl. 254—29)

This invention relates to tensioning units and, more particularly, to tensioning units which are particularly well adapted for tensioning cables used in pre-stressed concrete, and the like.

It is a primary object of the present invention to afford a novel tensioning unit for tensioning cables and the like.

Devices have been heretofore known in the art for tensioning cables in the production of pre-stressed concrete, and the like. However, such devices as have been heretofore known in the art have had several inherent disadvantages such as, for example, being large and cumbersome in size; being difficult and complicated in construction and operation; not being reliable in operation; being expensive to manufacture; or not being readily portable, and the like. It is an important object of the present invention to overcome such disadvantages.

Another object of the present invention is to afford a novel tensioning device of the aforementioned type which is relatively small and compact in size.

Another object is to afford a novel tensioning device of the aforementioned type which is readily transportable.

Yet another object is to afford a novel tensioning device of the aforementioned type which may be quickly and easily attached to a cable to be tensioned, and which may be quickly and easily released from such a tensioned cable.

A further object is to afford a novel tensioning device of the aforementioned type which is relatively simple in construction, and yet is practical and reliable in operation.

Another object is to afford a novel tensioning device of the aforementioned type which is practical and efficient in operation, and which may be readily and economically produced commercially.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is a fragmentary perspective view of a tensioning unit embodying the principles of the present invention, showing the unit disposed in operative position relative to a cable to be tensioned;

FIG. 2 is a top plan view of the tensioning unit shown in FIG. 1;

FIG. 3 is a fragmentary longitudinal sectional view taken substantially along the line 3—3 in FIG. 2;

FIG. 4 is a fragmentary top plan view of a portion of the unit shown in FIG. 2, with certain parts disposed in different operative position;

FIG. 5 is an elevational view of the unit shown in FIG. 1, looking in the direction of the arrows 5—5 in FIG. 2;

FIG. 6 is a transverse sectional view taken substantially along the line 6—6 in FIG. 2;

FIG. 7 is a transverse sectional view taken substantially along the line 7—7 in FIG. 2;

FIG. 8 is an end elevational view of the chuck embodied in the transfer unit shown in FIG. 1;

FIG. 9 is a longitudinal sectional view taken substantially along the line 9—9 in FIG. 8;

FIG. 10 is a longitudinal sectional view similar to FIG. 9, but showing certain parts in different operative position; and

FIG. 11 is a transverse sectional view taken substantially along the line 11—11 in FIG. 9.

A tensioning unit 1 embodying the principles of the present invention is shown in the drawings to illustrate the presently preferred embodiment of the present invention.

The tensioning unit 1 embodies, in general, an elongated supporting frame 2 on which is mounted a fluid-actuated unit 3, with the fluid-actuated unit 3 operatively connected to an elongated cable-gripping member, in the form of a chuck 4 for reciprocating the chuck 4 longitudinally of the supporting frame 2.

The supporting frame 2 includes two substantially flat, rectangular-shaped, end plates 5 and 6 disposed in parallel relation to each other, and two elongated, substantially straight side rods 7 and 8 extending between respective end portions of the end plates 5 and 6 in substantially parallel relation to each other. The end plates 5 and 6 and the side rods 7 and 8 may be made of any suitable material such as, for example, steel, and may be suitably secured together such as, for example, by welding.

The fluid-actuated unit 3 includes an elongated cylinder 9 having cylinder heads 10 and 11 mounted on the respective opposite end portions thereof. The cylinder heads 10 and 11 are held on the cylinder 9 by tie bolts 12 extending between the cylinder heads 10 and 11 radially outwardly of the cylinder 9.

The cylinder head 11 includes an inner wall 13, an outer wall 14, and an upper wall 15. The cylinder head 11 is hollow, and the cylinder 9 extends through the inner wall 13 thereof, in threaded engagement therewith, into the cylinder head 11, terminating in inwardly spaced relation to the outer wall 14. The outer wall 14 is imperforate.

The cylinder head 10 includes an inner wall 16, an outer wall 17 and a top wall 18 and, like the cylinder head 11, is hollow. The other end of the cylinder 9 extends through the inner wall 16 in threaded engagement therewith, and terminates in inwardly spaced relation to the outer wall 17.

An end plate 19, which is preferably of the same size and shape as the end plate 6 of the supporting frame 2, is secured to the outer face of the end wall 17 of the cylinder head 10 in parallel juxtaposition thereto. The plate 19 is of such size that the ends thereof project outwardly beyond the cylinder head 10, and the end plate 19 is secured to the outer face of the end plate 6 of the supporting frame 2 in parallel juxtaposition thereto by suitable securing members such as bolts 20.

The fluid-actuated unit 3 includes the usual piston 21 slidably mounted in the cylinder 9 for reciprocation longitudinally thereof. The piston 21 includes an end portion 22 which extends outwardly through the cylinder head 10 and the end plates 6 and 19 in longitudinal alignment with the cylinder 9. The end portion 22 of the piston 21 extends along the longitudinal center line of the frame 2 and has a supporting member 23 mounted on the free end thereof.

The supporting member 23 is substantially rectangular in shape, and includes two substantially flat, rectangular-shaped end walls 24 and 25 disposed in parallel spaced relation to each other. It also includes two substantially flat, rectangular-shaped side walls 26 and 27 extending between respective end portions of the end walls 24 and 25 in parallel spaced relation to each other. The supporting member 23 is open at the two sides thereof which extend perpendicular to the side walls 26 and 27. The

free end of the end portion 22 of the piston 21 extends through the end wall 25 of supporting member 23 between the side walls 26 and 27, and the supporting member 23 is secured thereto by suitable means such as, a nut 28.

A round abutment member 29 having a flat outer face 30 and a flat inner face 31 disposed in substantially parallel spaced relation to each other, is secured to the outer face of the end plate 5 of the supporting frame 2 in centered relation thereto, with the inner face 31 of the abutment member 29 disposed in parallel juxtaposition to the outer face of the end plate 5, FIGS. 1, 2, and 5. An outwardly opening slot 32 extends radially outwardly through the abutment member 29 from the radial center thereof, and two other slots 33 and 34, corresponding in size and shape to the slot 32, extend through the end wall 5 of the frame 2 and the end wall 24 of the supporting member 23 respectively, in alignment with the slot 32 for a purpose which will be discussed in greater detail presently.

The elongated chuck 4, for releasably gripping a cable to be tensioned, is mounted in the supporting member 23 in laterally centered relation thereto between the end wall 24 and the end 22 of the piston 21. The chuck 4 may be secured in position in the supporting member 23 by any suitable means, but I prefer to releasably secure it in the supporting member 23 by clamping it between the nut 28 and the end wall 24, FIG. 2, with a sufficiently tight fit that it is necessary to tap the chuck into position with a hammer.

The chuck 4 includes a tubular housing 36 having a substantially cylindrical-shaped bore 37 in one end 38 thereof, FIGS. 9 and 10, and a substantially frusto-conical-shaped bore 39 extending from the bore 37 longitudinally through the housing 36 and opening outwardly through the other end 40 thereof. The side walls of the bore 39 slope inwardly away from the bore 37 at a relatively small acute angle, preferably in the order of seven degrees.

Three elongated clamping jaws 41, 42, and 43, which are arcuate in transverse cross-section, are slidably mounted in the bore 39 in side-by-side relation to each other, FIGS. 8, 9, and 10. Each of the jaws 41–43 includes a narrow end face 44 and a wider end face 45 disposed in spaced parallel relation to each other, with an inner longitudinal face 46 extending between the end faces 44 and 45 in substantially perpendicular relation thereto. Each of the jaws 41–43 also includes an outer face 47, which slopes outwardly from the end face 44 to the end face 45 thereof at the same angle as the outward slope of the side walls of the bore 39. The clamping jaws 41–43 are mounted in the bore 39 of the housing 36 in arcuate alignment with each other in position to afford a tapered, three-piece clamping element 48, with the jaws 41–43 disposed annularly around the outer periphery of the bore 39.

The jaws 41–43 are of shorter length than the length of the bore 39, and the clamping element 48 is reciprocable within the bore 39 from a position wherein the end faces 44 thereof are disposed in uniplanar relation to the end face 40 of the housing 36, as shown in FIG. 9, and a position wherein the end faces 45 of the jaws 41–43 are disposed in uniplanar relation to the inner end of the bore 39, as shown in FIG. 10. The arcs of the clamping jaws 41–43 are of such length that when the jaws 41–43 are disposed in the aforementioned outer position, wherein the faces 44 thereof are disposed in uniplanar relation to the end wall 40 of the housing 36, space is still afforded between the adjacent jaws 41–43, FIG. 8.

With this construction, it will be seen that the clamping element 48 is afforded with a central bore 49, which extends longitudinally therethrough, and which is progressively reduced in diameter as the clamping element 48 moves outwardly from the position shown in FIG. 10 toward the outer position shown in FIG. 9. The clamping element 48 is so constituted and arranged that when it is disposed in the aforementioned innermost position, the bore 49 is of considerably larger diameter than the diameter of the cable to be tensioned by my novel tensioning unit 1, and when the clamping element 48 moves outwardly toward the aforementioned outermost position thereof, the bore 49 is reduced in diameter to such an extent that the clamping jaws 41–43 are disposed in position to firmly grip any such cable disposed in the bore 49.

A plug 50 having an enlarged head 51, from one side of which a threaded shank 52 extends, is mounted on the end 38 of the housing 36 with the shank 52 threaded into the bore 37. An opening 53, which preferably is at least of the same diameter as that of the bore 49 in the clamping element 48 when the latter is fully expanded in the housing 36, extends longitudinally through the shank 52 and the cap 51. The head 51 of the plug 50 is preferably of the same transverse cross-sectional size as the housing 36, and the outer surface thereof may be suitably roughened such as, for example, by knurling, to facilitate the insertion and removal of the plug 50.

A compression coil spring 75 is mounted in the housing 36 of the chuck 4 between the plug 50 and the clamping element 48, in position to, at all times, yieldingly urge the clamping element 48 toward the aforementioned outermost position shown in FIG. 9. The internal diameter of the spring 75 is substantially larger than the diameter of the bore 53, and the spring 75 is of such outside diameter as to insure that the spring 75 is at all times spaced radially outwardly of the bore 53.

An elongated, substantially trough-shaped releasing member 54 is mounted in the slot 34 in the end plate 5 of the supporting frame 2 in inwardly projecting relation thereto, FIG. 4. The internal arch of the releasing member 54 is of the same size and shape as the inner end portions of the slots 32–34, FIG. 5, and the outer arch of the releasing member 54 is of such a size that the releasing member 54 may fit into the bore 39 in the end 40 of the housing 36 of the chuck 4 with a relatively snug, but freely slidable fit, for a purpose which will be discussed in greater detail presently.

Two coupling members 71 and 72 are mounted in the top walls 18 and 15 of the cylinder heads 10 and 11, respectively, and are in communication with the hollow interiors of the cylinder heads 10 and 11. The other ends of the connecting members 71 and 72 may be connected by suitable conduit means such as, for example, hoses 73 and 74, respectively, to a suitable, controlled source (not shown) of working fluid such as, for example, a source of hydraulic fluid such as, for example, a hydraulic pump having suitable valves associated therewith. By alternately feeding the hydraulic fluid into the hoses 73 and 74, and exhausting the other hoses 74 and 73, respectively, to sump, the piston 21 may be caused to reciprocate in the cylinder 9 in a manner well known in the art.

Such reciprocation of the piston 21 is effective to reciprocate the supporting member 23 and, therefore, the chuck 4 between a position wherein the end wall 24 of the supporting member 23 is disposed in closely adjacent relation to the end plate 5 of the supporting frame 2, as shown in FIG. 2, and a position wherein the supporting member 23 is disposed in inwardly spaced relation to the end plate 5, as shown in FIG. 4. When the supporting member 24 is disposed in the outermost position, shown in FIG. 2, the releasing member 54 extends through the slot 34 into the outer end of the bore 39 in the housing 36 of the chuck 4, in which position it is effective to hold the clamping element 48 in fully retracted position, as shown in FIG. 10. When the supporting member 23 is disposed in an inwardly disposed position, such as that shown in FIG. 4, the supporting member 23 is disposed in inwardly spaced relation relative to the releasing member 54, so that the latter is ineffective to hold the clamping element 48 in retracted position in the housing 36 of the chuck 4, and the clamping element 48 is free to move outwardly under the urging of the spring 75 toward the outermost position thereof shown in FIG. 9. Thus, it

will be seen that during reciprocation of the supporting member 23, and therefore, the chuck 4 with the piston 21 between the positions shown in FIGS. 2 and 4, the clamping element 48 is alternately pushed inwardly by the releasing member 54 into the housing 36 to thereby permit expansion of the bore 49 therein, and moved outwardly, under the urging of the spring 75 in the bore 39 of the housing 36 to thereby reduce the size of the bore 49. As will be discussed in greater detail presently, this affords automatic operation for clampingly engaging, and releasing, a cable to be tensioned in my novel tensioning unit 1, during operation of the latter.

In FIG. 1 my novel tensioning unit 1 is shown in operative position relative to a form 55 for producing prestressed concrete 56 having a plurality of cables therein, two such cables 57 and 62 being shown therein. The form 55 and the concrete 56 are of a type which are well known in the art, and the showing thereof in FIG. 1 is fragmentary, this being sufficient for an understanding thereof by those skilled in the art. It will be appreciated by those skilled in the art that the form 55 may be of any suitable type well known in the art, the form 55 shown in FIG. 1 including two outer side walls 58 and 59 disposed in substantially parallel spaced relation to each other, and two inner side walls 61 and 62 disposed in substantially parallel spaced relation to each other between the side walls 58 and 59, and in inwardly spaced parallel relation to the latter. It will be understood that suitable supporting members and bracing members, not shown, will be attached to the walls 58–61 to hold the walls 58–61 in the aforementioned operative positions relative to each other.

In the formation of concrete 56 of the type shown in FIG. 1, cables such as the cables 57 and 62 are first inserted through the walls 58–61 in proper position in the form 55. A plurality of suitable holding devices 63 may then be secured to the ends of the cables 57 and 62 projecting outwardly from the wall 58 of the form 55 in position to hold the cables 57 and 62 against an inward pull thereon. If desired, the holding devices 63 may be identical in construction to the chuck 4, and if such units are used, the ends 40 thereof would be disposed against the outer face of the wall 58, with the cables 57 and 62 extending through the holding devices 63. Thereafter, suitable holding devices 64 may be secured to the ends of the cables 57 and 62 projecting outwardly from the side wall 59 of the form 55 in position to hold the tension on the respective cables 57 and 62 after the tension has been applied thereto. If desired, these holding units 64 may also be identical in construction to the chuck 4, and if such units are used, the ends 40 thereof would be disposed in engagement with the outer face of the side wall 59 with the cables 57 and 62 extending through the chucks 64, and with free end portions 65 of the cables 57 and 62 extending outwardly from the holding units 64.

In the operation of my novel tensioning unit 1, the free end of the cable to be tensioned such as, for example, the free end 65 of the cable 57, may be inserted through the slots 32–34 into the bore 49 in the clamping jaw 48, with the supporting member 23 disposed in the fully outwardly disposed position shown in FIGS. 1, 2 and 10, wherein the releasing member 54 is effective to hold the clamping unit 48 in fully retracted position, as shown in FIG. 10. If desired, the free end 65 of the cable 57 may be extended entirely through the chuck 4. However, this is not essential, and it is merely necessary that the free end 65 extend into the chuck 4 a sufficient distance that it may be effectively gripped by the clamping element 48 during an operation of the unit 1.

Thereafter, the tensioning unit 1 may be moved into position wherein the outer face 30 of the abutment member 29 is disposed in abutting engagement with the outer end of the holding device 64 on the cable 57, and the fluid-actuated device 3 may then be actuated to cause the

piston 21 to move away from the end plate 5 of the supporting frame 2. Such movement of the piston 21 is effective to correspondingly move the supporting member 23 and the chuck 4 to thereby move the chuck 4 into inwardly spaced relation to the releasing member 54. Such movement of the chuck 4 frees the clamping element 48 for movement outwardly through the bore 39 in the chuck 4 under the urging of the spring 75, into frictional engagement with the outer peripheral surface of the free end 65 of the cable 57. Thereafter, continued movement of the chuck 4 in such direction is effective to cause the clamping jaws 41–43 to increase their clamping pressure on the cable 57 and thereby firmly grip the latter. With the free end 65 of the cable 57 thus firmly gripped in the chuck 4, continued movement of the chuck 4 to the right, as viewed in FIG. 2, is effective to tension the cable 57, the cable 57 being pulled through the holding member 64 mounted thereon.

After the cable 57 has been tensioned to the desired extent, the operation of the fluid-actuated unit 3 may be reversed to thereby cause the piston 21 and the supporting member 23 to move to the left, as viewed in FIGS. 2 and 4, and as the supporting member 23 moves toward its normal at-rest position, adjacent to the end plate 5 of the supporting frame 2, shown in FIG. 2, the releasing member 54 enters the bore 39 in the chuck 35 and moves the lamping element 48 inwardly into the enlarged portion of the bore 39 in the housing 36 to thereby free the chuck 4 from gripping engagement with the end portion 65 of the cable 57. However, it will be remembered that the holding unit 64 is mounted on the free end portion 65 of the cable 57 in holding relation thereto, so that release of that free end portion 65 by the chuck 4 does not release the tension on the cable 57 between the side walls 58 and 59 of the form 55, the tension on that portion of the cable 57 being held by the holding units 63 and 64 attached thereto.

After tensioning one of the cables, such as the cable 57, the tensioning unit 1 may be withdrawn therefrom, and the cycle of operaion repeated on the next cable which is to be so tensioned, such as, for example, the cable 62. This operation may be repeated on each cable to be tensioned in the form 55, and after all of the cables have been properly tensioned, the concrete 56 may be poured into the form 55 between the side walls 60 and 61. After the concrete 56 has set to the desired extent, the tension on the cables between the holding devices 63 and 64 may be released in any suitable manner such as, for example, by cutting the cables, such as the cables 57 and 62 between the walls 58 and 60, and the walls 59 and 61, respectively. This operation releases the tension on the holding units 63 and 64, and they may then be released from the free end portions of the cables on which they are mounted. The finished concrete 56 with the tensioned cables, such as the cables 57 and 62, therein may then be removed from the form 55.

It will be appreciated by those skilled in the art that although the openings 32–34 are shown herein as slots, and the releasing member 54 is shown as trough-shaped, the openings 32–34 may be different shape, such as round openings, and the releasing member 54 may be of different shape, such as tubular, with the end of the cable to be tensioned being inserted and withdrawn axially therethrough.

From the foregoing it will be seen that the present invention affords a novel and practical tensioning unit for tensioning cables in concrete forms, and the like.

Also, it will be seen that the present invention affords a novel tensioning unit of the aforementioned type which may be constructed in such a size, and of such a weight that it may be readily transported and easily handled.

In addition, it will be seen that the present invention affords a novel tensioning unit which may be quickly and easily attached to and released from such a cable in a novel and expeditious manner.

Also, it will be seen that the present invention affords a novel tensioning unit which is practical and efficient in operation and may be readily and economically produced commercially.

Thus, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. An apparatus for tensioning cables, comprising, in combination,

(1) a fluid actuated driving unit including,
  (a) a rear frame assembly
  (b) a cylinder supported in said frame assembly
  (c) a piston reciprocable in said cylinder
  (d) front and rear end cylinder heads on said cylinder, including a front opening in said front end cylinder head,
  (e) a forwardly extending piston rod attached to said piston and extending through said opening, and
  (f) means for supplying driving fluid to either end of said cylinder for reciprocably driving said piston and said rod,

(2) a front frame and chuck holder assembly including,
  (a) rigid members forming the sides of said front frame, and disposed across said members and forming the front end portion of said frame,
  (b) a rigid front plate including a front surface portion for abutting the rear of a chuck disposed on a cable to be tensioned, and for preventing rearward movement of said chuck during tensioning of the cable, while applying a tensioning force to said cable, and
  (c) a chuck holder attached to said piston rod and reciprocable between said front end plate and said front cylinder head, said chuck holder including a cable receiving slot in the front face thereof.

2. An apparatus as defined in claim 1 which includes a cut-out portion in said chuck holder for allowing chuck-releasing means to extend therethrough for engaging and releasing the movable jaws of a chuck held in said chuck holder.

3. An apparatus as defined in claim 1 in which said rigid front plate also includes chuck-releasing means disposed on the inner side of said front plate and extending rearwardly therefrom.

4. An apparatus as defined in claim 1 in which said chuck holder includes a cut-out portion for allowing chuck-releasing means to extend therethrough for engaging and releasing the movable jaws of a chuck held in said chuck holder, and in which said rigid front plate includes chuck-releasing means disposed on the inner side of said front plate and adapted to extend rearwardly therefrom and through said cut-out portion when said chuck holder is in a forward position.

5. An apparatus for tensioning cable in a concrete prestressing operation, said apparatus comprising in combination,

(1) a fluid cylinder including two cylinder heads therefor the front cylinder head having an opening therein,
(2) said heads each having means for admitting fluid thereinto,
(3) a reciprocably movable piston disposed in said cylinder,
(4) means for supplying fluid to either end of said cylinder to reciprocate said piston,
(5) a reciprocable rod attached to said piston and extending through said opening in said front cylinder head,
(6) a generally rectangular reciprocable open-sided chuck holder fixedly attached to said rod, said holder including a cable receiving slot therein,
(7) an automatically-actuatable cable chuck mounted in said chuck holder and adapted to normally receive and automatically frictionally engage by movement thereof a cable to be tensioned,
(8) said cable being tensioned by movement of said reciprocable holder and automatic chuck in a first direction upon the supply of fluid to a given end of said cylinder, and released by said chuck automatically by movement in the opposite direction,
(9) forwardly extending frame means within which at least said reciprocable chuck holder and said automatically-actuatable chuck travel, said frame means including side rails and end walls, one end wall secured to one face of the front cylinder head, the other end wall including a cable receiving slot therein in alignment with said slot in said chuck holder,
  (a) said other end wall of the frame means including a portion thereof normally abutting the rear of a cable holding unit in normal engagement with said cable being tensioned, said portion preventing movement of said holding unit during reciprocation of said reciprocable chuck holder and automatic chuck whereby the desired tension of said cable is achieved by reciprocation of said chuck holder and automatically-actuatable cable chuck.

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WILLIAM FELDMAN, *Primary Examiner.*

DONLEY J. STOCKING, *Examiner.*